EXPERIMENT 1 **Chemistry 110**

LABORATORY SAFETY

MEASUREMENTS

PURPOSE: The Purpose of this laboratory exercise is for the students to develop the skills of measuring length, volume, mass and temperature and to perform simple unit conversions and to learn about laboratory safety.

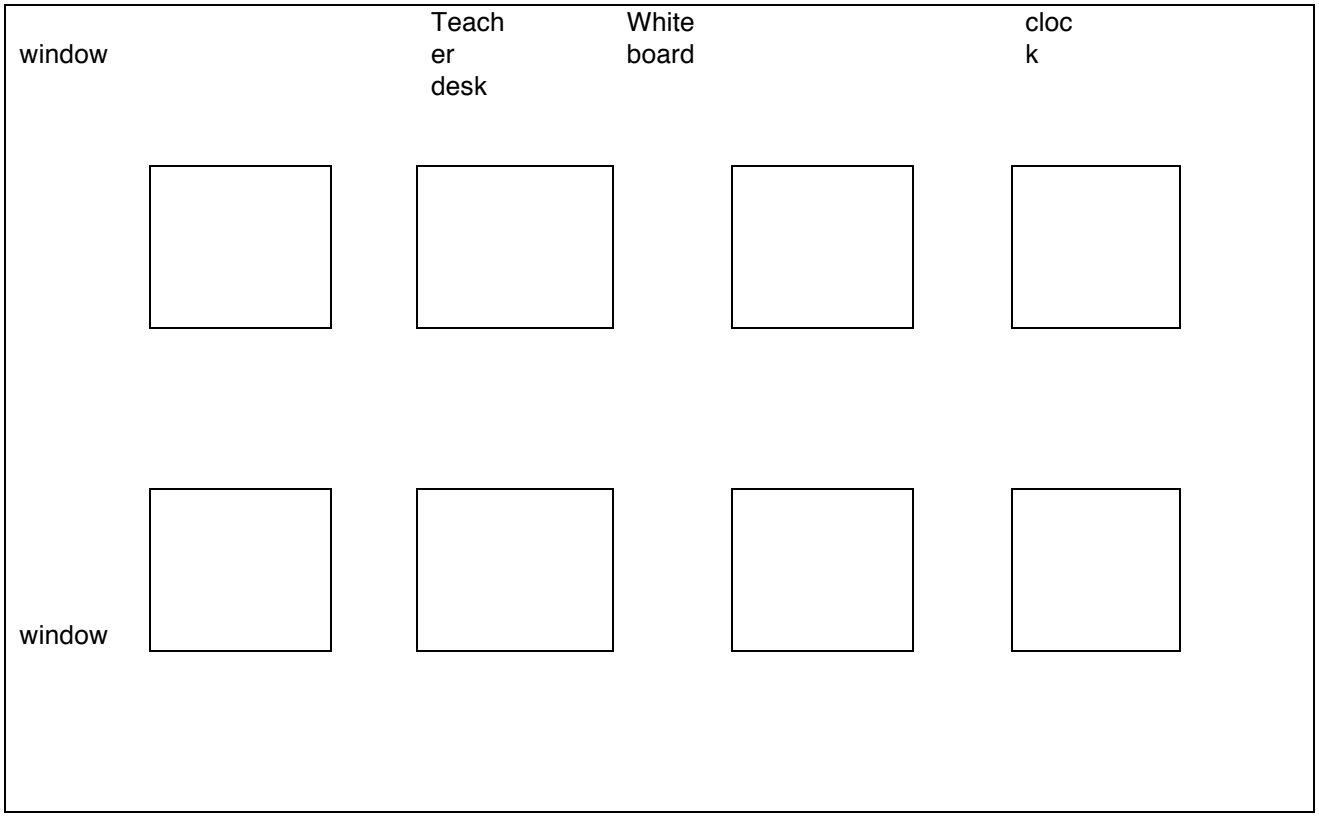
I. LABORATORY SAFETY

Laboratory work is basic to any scientific pursuit. It is important to learn safety in the laboratory. Download and read the safety pamphlet from the Cerritos College Chemistry Department Website. Read it carefully and take the practice quiz. Next week you will be given one safety quiz. You must pass the safety quiz with at least 45 out of 50 correct responses or you will receive am "F" grade for the lab portion of the course. Refer to the syllabus for more details. Your lab instructor will show you a safety film and discuss specific safety topics pertaining to your lab work for this semester.

Place each of the following pieces of safety equipment in the correct location on the map of the room below.

Safety Equipment

Large sinks	Emergency shower	Eye wash
Fire extinguisher	First aid kit	Fume Hoods
Escape routes	Fire Blanket	



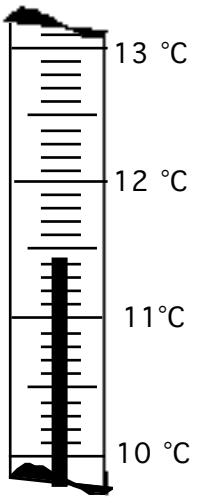
Instructors Initials_____

II. MEASUREMENTS

Measurements are basic to any scientific pursuit. A measurement has both a magnitude (numerical value) and a unit. Metric units are used in the sciences.

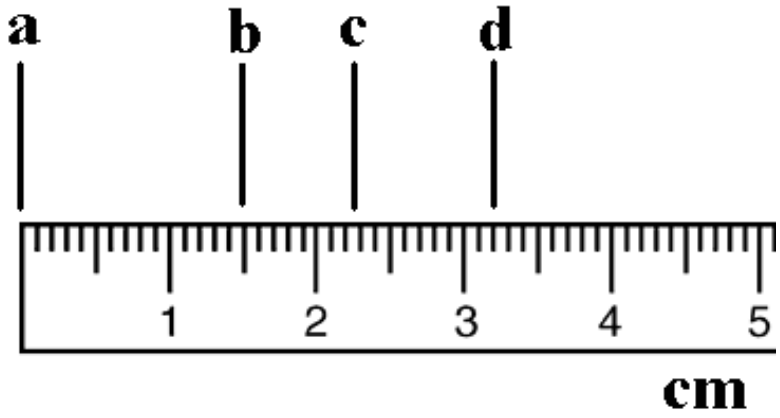
Metric System

In science, the metric system is used almost exclusively. In the metric system, the base unit of length is meters; of mass it is grams; of volume it is liters (liquids) or cubic meters (solids) and of temperature it is Celsius. To change the magnitude of a base unit a prefix is placed in front of the base unit. These prefixes are various powers of ten. Scientific measurements will have a magnitude and unit. 55.5 cm, for example, has a magnitude of "55.5" and the unit is cm (abbreviation for centimeters) indicating the measurement was of a length. When you make a measurement, always record it with a number and unit. For example: 22.53 mm, 34.00 °C, 1.5478 g, or 45.0 ml.



The mercury in this thermometer is between 11.4 and 11.5 you need to estimate (interpolate) the last digit. The reading should be written as 11.42 °C . (It is understood that it is 11.42 °C ± 0.01°C.)

In the laboratory, measurements must be accurate. Due to inexact tools and faulty observations, measurements are subject to error; they are never absolutely exact. Scientific measurements are made from scales. Data should generally be recorded to one decimal place beyond the instrument's calibration. This requires estimating "between the lines" (interpolate) to determine the last digit.

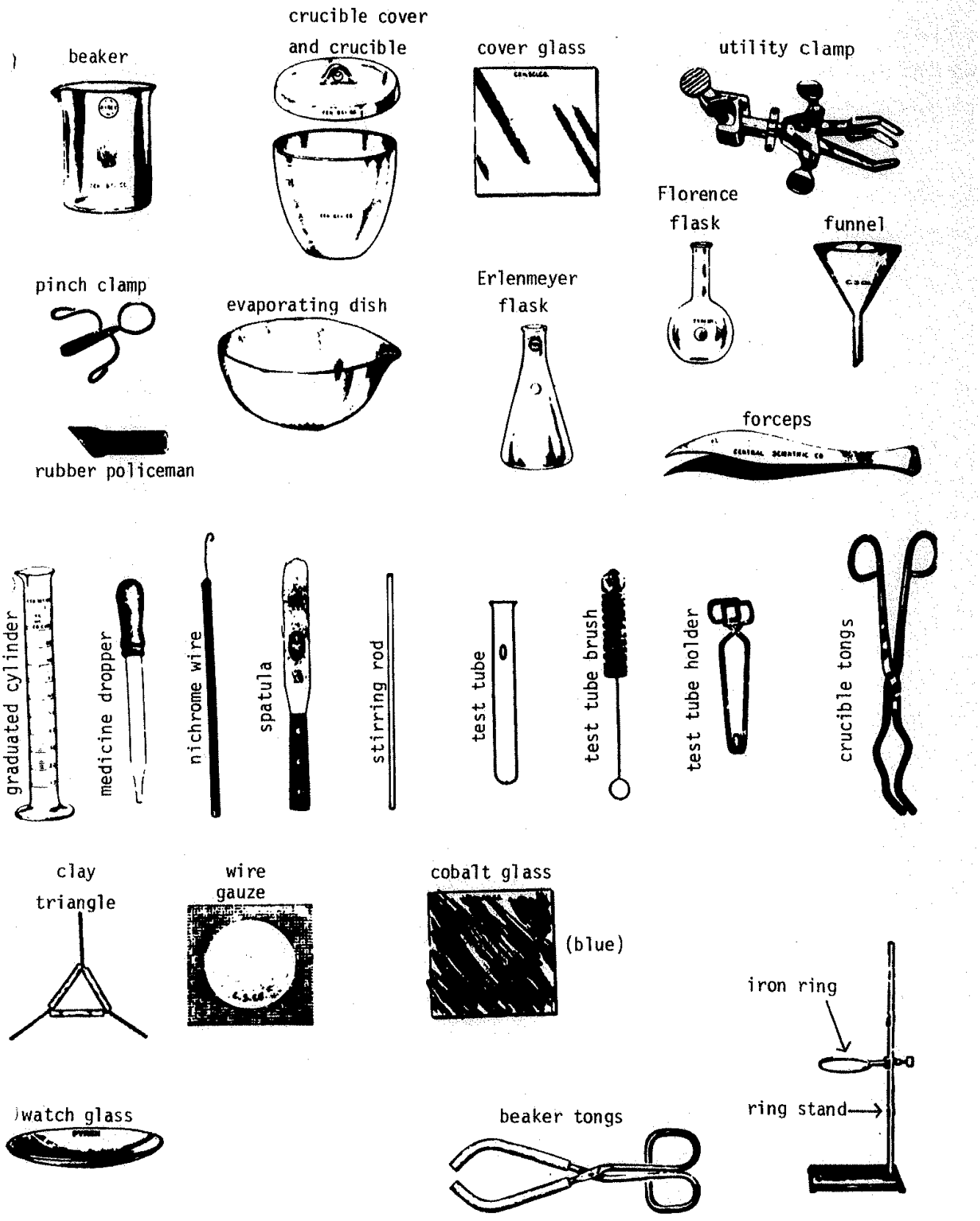


The lines on this ruler are to the 1/10 or 0.1 cm. So the measurement must include one estimated digit which would be to 0.01 cm or 1/100 cm. In the case of measurement “a” the student would write 0.00 cm. The marks on the ruler with numbers are cm and the smallest marks are mm. The measurement would be written with the units “cm” and the number must go to 0.01 cm. If the measurement falls directly on the line the last digit would be “0”. In measurement b the value is 1.50 cm not 1.5 cm. If the measurement falls in between the lines as in the case of measurement c the value written must have one estimated digit. The first digits must be exact and the last digit is estimated. This means that different students may have slightly different numbers for the last digit. In the case of measurement c the value could be written 2.24 cm or 2.25 cm or 2.26 cm or 2.27 cm. Notice that all the values have the same first two digits. Those are not estimated, but the last digit is estimated. A measurement of 2.21 cm would include a poor estimate.

What is the value with correct digits and units for measurement d? _____

Instructors Initials_____

LABORATORY APPARATUS



II. PROCEDURE

A Length

1. Obtain a Metric-English ruler from the side shelf. Note that one edge is in inches and the other is in centimeters. On the metric side, the numbers on the large lines are in centimeters and the lines marking the smallest divisions are in millimeters.
2. Draw a line five inches long in the space below. Using the metric side of the ruler, measure the length of your 5 inch line in centimeters.

Length = _____cm

3. What is this length in millimeters? Length = _____mm

4. Divide the centimeter measurement obtained in #2 by five inches to obtain the cm to inch ratio. This will give you a conversion factor to convert centimeters to inches and vice-versa.
   Calculation:

$$\frac{\text{\_\_\_\_\_ cm}}{5.00\ \text{in}} =$$

Answer = _____ $\frac{\text{cm}}{\text{in}}$

B Temperature

Scientific thermometers are calibrated in Celsius or Kelvin (for gas measurements). These thermometers are not the same as the thermometers used to measure body temperature. **They should never be "shaken-down".**

1. Obtain a thermometer and small beaker from the reagent bench. Put about 30 ml of tap water into the beaker. Measure the temperature of cold tap water and record. Then run the hot tap until the water is hot. Repeat the procedure and measure the temperature. Make sure to go to the tenths place.
   NOTE: You must include units in your reading! For example, if the thermometer reads "29.3 Celsius", you would write 29.3 °C.

Substance measured	°C
Temperature of cold water	
Temperature of hot water	

Did you remember to include the unit °C" (for Fahrenheit or Celsius) in your measurement? Did you include an estimate to the tenths place?

Instructors initials_____

C MASS

The top loading balances are located on the bench by the windows. Mass measurements are made to the second decimal place (+ 0.01 g). When using the balance the following guidelines must be followed:

1. Never place chemicals directly on the balance pan. Use a weighing paper, filter paper or a container (beaker, graduated cylinder, and etc.) to hold chemicals.
2. Always check to see if the balance is clean before using. If not, use the brush to clean.
3. Push the ON button. Allow the balance to calibrate. When the balance reads "0.00", it is ready to weigh. If the balance does not read zero, push the side of the lever that reads "zero".
4. When using the balance, fluctuation in the last decimal place may occur due to disturbances near the balance pan. Record the most stable weighing, that is, the one you see remaining on the display for the longest period of time.

Obtain two metal plates from the side shelf and weigh:

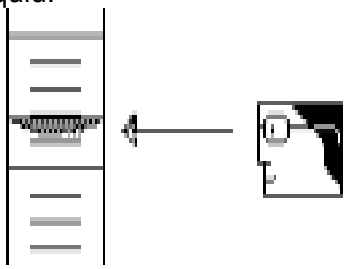
Metal plate number	Mass, grams

Did you remember to include the unit "g" (for grams) in your measurement?

Instructors initials_____

D. Volume

A graduated cylinder is used to measure the volume of liquids. The curved surface of the water inside the cylinder is called a meniscus. Read the volume at the bottom of the curve of the meniscus, with your eye level at the surface of the liquid.



1. Obtain a 4 inch test tube, 50 and 100 ml beaker, and a 10 and 100 ml graduate cylinder.
2. Fill the test tube and beakers to the very top of the beaker and measure the volume using the appropriate graduate cylinder.

	Volume	
4 inch test tube		Use 10ml grad. cylinder and estimate to the 0.01 place. Example: measure 6.62 ml not 6.6 ml
50 ml beaker		Use 100 ml grad. cylinder and estimate to the 0.1 place. Example: Measure 35.6 ml not 35.65, not 35 ml
100 ml beaker		Example: Measure 35.6 ml not 35.65, not 35 ml

Did you remember to include the unit "ml" (for milliliters) in your measurement?

Instructors initials_____

NOTE: **Please empty the water from the glassware and return any equipment not in use for others to use!**

E. Indirect Measurements

Some measurements are difficult to make due to its size; therefore, an indirect method must be used. For example, the mass of a single drop of water is nearly impossible to measure in your 10 ml graduate cylinder and Mettler balance. Therefore, you must measure the mass of many drops and then calculate the mass a single drop.

Indirect determination of the mass and volume of one drop of water

1. Determine the mass of an empty/ reasonably dry, 10 mL graduated cylinder and record below.
2. Add 45 drops of deionized water.
3. Read and record the volume.
4. Weigh the graduate cylinder with the water and record the mass.

NOTE: Calculations will be done on the calculation table which follows the data table..

DATA

DATA	
Mass of 10 ml graduated cylinder	
Mass of graduated cylinder plus 45 drops of water	

Calculate the mass of one drop of water below.

CALCULATIONS	Set-up	Answer
Mass of 45 drops of water		
Mass of one drop of water		

Do you have units on all of your answers?

Practice (To be completed before obtaining instructor's initials)

Some simple metric-metric conversions You must show all work and units

1. How many ml in 25.2 L?

Answer_____

2. 455.76 kg is how many g?

Answer_____

3. 65.1 L = ? dl?

Answer_____

Before you leave the lab you must have your lab instructor initial your report sheet.
NO CREDIT will be given for lab reports without the instructor's initials!

Leave page blank or double sided printing

Chem 110 Lab Report **(This is what gets turned in next week)**

Name _____ Date _____

Lab Section _____ Initials_____

EXPERIMENT 1

Measurements

A Length

Length = _____cm

What is this length in millimeters? Length = _____mm

Divide the centimeter measurement obtained by five inches to obtain the cm to inch ratio.

Calculation:

$$\frac{\text{\_\_\_\_\_ cm}}{5.00\ \text{in}} =$$

Answer = _____ $\frac{\text{cm}}{\text{in}}$

B Temperature

Substance measured	°C
Temperature of cold water	
Temperature of hot water	

C MASS

Metal plate number	Mass, grams

D. Volume

	Volume
4 inch test tube	
50 ml beaker	
100 ml beaker	

E. Indirect Measurements

DATA

DATA	
Mass of 10 ml graduated cylinder	
Mass of graduated cylinder plus 45 drops of water	

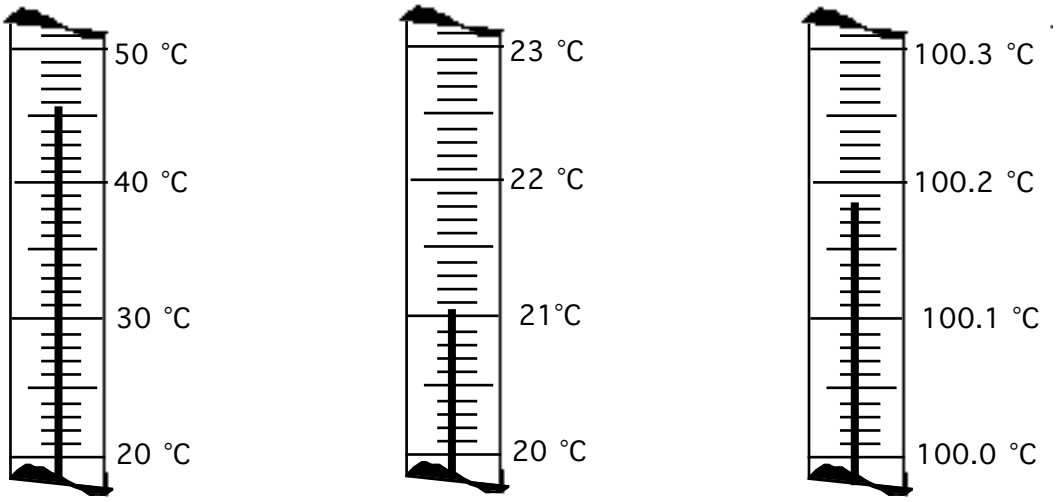
CALCULATIONS

CALCULATIONS	Set-up	Answer
Mass of 45 drops of water		
Mass of one drop of water		

Practice:

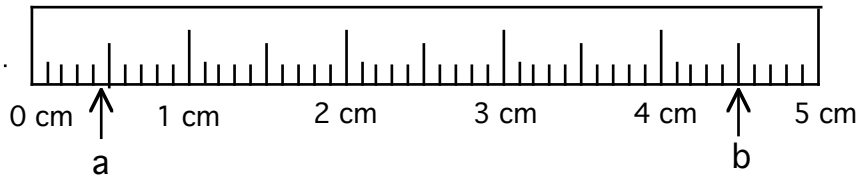
Read the following scales. Record the correct number of digits and include units.

1.



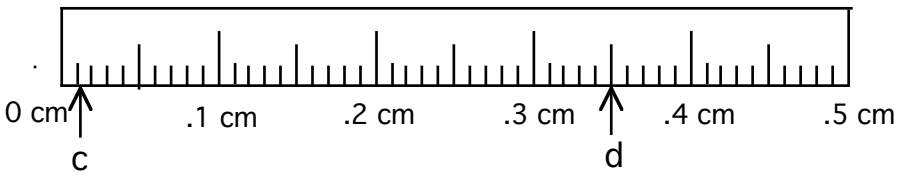
Answers _____ _____ _____

2.



Answers a _____ b _____

3.



Answers c _____ d _____

Some simple metric-metric conversions You must show all work and units

1. **How many g in 251 mg?**

Answer_____

2. **22.351 kl is how many L?**

Answer_____

3. **65.155 m = ? dm?**

Answer_____

Don't forget!

1. Safety quiz is the second meeting of lab. You must get 90% correct

2. Bring all lab procedures with you to class

3. Be prepared for the lab quiz on this experiment. You will be asked similar questions and similar calculations on the quiz.